What Planners Need to Know About Autonomous Vehicles

Perspectives from the Research Community and Directions for Future Research

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Autonomous Vehicles: The Impacts of a Disruptive Technology

The adoption of AVs will likely lead to large impacts on:

- ***Transportation supply***
  - E.g. increased capacity through platooning vehicles at higher speeds, etc.
- ***Transportation demand***
  - Increased flexibility in scheduling trips
  - Reduced effort and stress associated with driving
  - Ability to use time productively while traveling
  - Increased availability of personal vehicles for the mobility-limited (including the *temporarily impaired*, e.g. due to drinking)
  - Repositioning trips undertaken with no passengers (*zero-occupancy vehicles*)
  - Effects induced by the increased supply
  - (*among others…*)

Impacts on Individuals' Behavior

- AVs will change the way we: travel, participate in activities, interact with others…
- Potential impacts on land use/residential location
- Impact on congestion/people livability
- Impact on the transportation industry (and beyond)
- Potential substitution with other means of travel
- Potential induced demand
- *Important policy implications!*

Acknowledgements: Yoram Shiftan, Joan Walker, Dimitris Milakias and Siva Srinivasan

Behavior is a Key to Impact

- AVs can lead to desirable outcomes: ***all will share…***

OR

- AVs can result in the nightmare of transportation planners: ***all will travel more…***

There is a pressing need to understand what policies/ scenarios will affect the use of AVs

Unfortunately, it is difficult to predict the future of mobility after the adoption of AVs, as they do not currently exist!

Typology of Research Objectives

- Ownership/Use
- Travel behavior/Mode choice
- Activity participation/Lifestyles
- Land use effects /Residential location

Main Research Approaches

1) Stated preference (SP) studies

2) Driving simulators and controlled testbeds

3) Simulation based/scenario analysis studies

For more details:

Shiftan, Y., J. Walker, and R. Daziano (2015) "Behavioral framework and choice experiments for modeling the implications of autonomous vehicles". 14th Conference of the International Association of Travel Behavior Research (IATBR), Windsor, UK, July 2015

Assessing the Behavioral Impacts of AVs: Stated Preference Studies

Willingness to Pay for Autonomous Vehicle Features:

- Are consumers willing to pay to let the car drive for them? What are the impacts on the use of the vehicle? *Ricardo Daziano (Cornell University)*
- What are consumers willing to pay for various levels of vehicle automation? *Kara Kockelman (UT Austin)*

Impacts on Mode Choice:

- Willingness to pay for shared and pooled vehicles. What is the impact on the use of other modes? *Francesco Ciari, Kay Axhausen (ETH Zurich)*

Changes in the Value of Travel Time:

- How will AVs impact the value of travel time, mode choice and VMT? What is the relationship with trip purposes? *Stefan Trommer (German Aerospace Center*)

Preferences Regarding Autonomous Vehicles:

- What factors affect the decision to adopt AV technology? What are the reasons for hesitation among consumers? *Yoram Shiftan (Technion*)

Long-Term Effects of AV Adoption:

- To what extent multitasking decreases the value of travel time? What are the effects on residential location and on the substitution of transit with car travel? *Eric Molin (TU Delft)*

Stated Preferences, Virtual Reality, Gaming, Simulators

Willingness to Pay for Autonomous Vehicle Features:

- One day travel summary, with future "nudging" through scenarios and future mobility video - *Simon Washington (Queensland University of Technology)*

Immersive Virtual Reality Experiments:

- Simulation of use of Avs, acceptance/reservation of technology and interaction with other road users - *Bilal Farooq (Polytechnique Montréal*), *Elisabetta Cherchi (DTU)*

Impact of experience on the attitudes towards AVs:

- E.g. evaluation of perceived safety – *Matthew Beck (University of Sydney)*

Reaction to driving in automated mode:

- Is tactical control desirable in AV mode? *Azra Habibovic (Viktoria Swedish ICT*)

Photo source: *Habibovic and Nilsson*

Activity-Based Models/ Scenario Analysis

A number of studies are being developed by various teams and in different regions, e.g. work developed by:

- *Cambridge Systematics*
- *San Francisco's MTC*
- *Atlanta Regional Commission*

Studies are usually based on a number of modifications in the model inputs, parameters of the models and/or ABM components

Complex interactions are simulated (but dependent on the model and scenario assumptions)

Analysis of model sensitivities, and of changes in model outputs and travel forecasts

What about RP data?

Still limited experience available with use of revealed preference (RP) data:

- Measurement of performance (ability to perform tasks) and trust while in AV simulator *(Chris Schwarz, University of Iowa)*
- Behavioral experiments to collect information in settings that are as close as possible to future mobility with AVs *(Joan Walker, UC Berkeley)*
- *Limited ability to collect RP data in a variety of settings…*

Impact of Travel Multitasking on Mode Choice: Implications for AVs

Use of revealed preference (RP) data collected with an empirical survey distributed among commuters in Northern California:

Mode-specific:

* Sacramento RT
* Capital Corridor (Amtrak)
* BART
* Yolobus
* UCD & Bay Area carpoolers

Organization-specific:

* Google
* Commuter Club
* UC Davis staff, students

Email blast:

* Infogroup

Mail blast:

* Random addresses along the Amtrak corridor

Online panel:

* Survey Analytics

3 weeks of paper survey distribution (~3,000)

\+ 3 months of online surveys (~30 varieties)

\+ 6 months of data entry, filtering and conditioning

Impact of Travel Multitasking on Mode Choice: Implications for AVs

- How do the activities conducted while traveling affect the utility of public transportation (*today*) and autonomous vehicles (*tomorrow*)?
- Mode choice model estimated with behavioral and attitudinal data collected in the study.
- To our knowledge, first study that uses RP data to capture the impact of travel multitasking on mode choice and VOTT
- Propensity to travel multitask accounts for a non-negligible slice of rail and carpool mode share
- Rail/transit's competitive advantage may be short-lived as driverless cars become a reality: scenarios suggest a *1.3-1.5 p.p. increase in drive-alone*
- The results can be used to inform scenario analysis and modeling studies

Acknowledgements: Patricia L. Mokhtarian, Aliaksandr Malokin

NCHRP
AASHTO

Impacts of CVs and AVs on State and Local Transportation Agencies NCHRP 20-102

- $3.5M authorized; future funds expected
- Contractors selected through limited, closed competition (prime contactors can add new subcontractors for any task proposal)
- 13 tasks funded to date, covering deployment, policy, planning, dissemination and data-related topics

NCHRP 20-102 Tasks

- Task 01 - Policy and Planning Actions to Advance Agency Goals Through CV and AV Systems
- Task 02 - Impacts of Regulations and Policies on CV and AV Technology Introduction in Transit Operations
- Task 03 - Challenges to CV and AV Applications in Truck Freight Operations
- Task 05 - Strategic Communications Plan for NCHRP 20-102
- Task 06 - Road Markings for Machine Vision
- Task 07 - Implications of Automation for Motor Vehicle Codes
- Task 08 - Dedicating Lanes for Priority or Exclusive Use by CVs and AVs

NCHRP 20-102 Tasks

- Task 09 - Providing Support to the Introduction of CV/AV Impacts into Regional Transportation Planning and Modeling Tools
- Task 10 - Cybersecurity Implications of CV/AV Technologies on State and Local Transportation Agencies
- Task 11 - Summary of Existing Studies on the Effects of CV/AV on Travel Demand
- Task 12 - Business Models to Facilitate Deployment of CV Infrastructure to Support AV Operations
- Task 13 - Planning Data Needs and Collection Techniques for CV/AV Applications
- Task 14 - Data Management Strategies for CV/AV Applications for Operations

For more information, please visit:
http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3824

Or contact Ray Derr, rderr@nas.edu

Thank you for your attention!


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